Toolbox 2 reflection

In physics and biomechanics, understanding how the body moves is key to analyzing things like joint mechanics and overall physical performance, which is useful for volleyball and leads into my final project. Traditionally, this kind of analysis relies on marker-based motion capture systems, which are accurate but also expensive and require controlled lab environments. That's where MediaPipe Pose comes in… it's a machine learning based tool developed by Google that can estimate body motion using just a regular video feed. It predicts 33 key body landmarks in real time, making it a surprisingly powerful and accessible option for motion tracking.

MediaPipe Pose works in two main stages. First, it runs a lightweight neural network that detects the region of interest — basically, it finds the person in the image and defines a bounding box around their body. Then, a second, more complex neural network takes that cropped image and predicts the positions of key joints like the elbows, knees, hips, and so on. These predictions include x and y image coordinates, an estimated z-depth value (relative to the body), and a visibility score for each landmark. When used on video, MediaPipe adds a temporal element by reusing previous frames to avoid re-detecting the person every time, and applies a filtering technique called the One Euro filter to smooth out jitter and create more stable, continuous motion tracking.

For physics, this opens up a ton of possibilities. You can use MediaPipe to model human motion as a multi-body system, track how limbs move, estimate joint angles, measure things like displacement, velocity, or acceleration, and compare those results to analytical models. For example, you could analyze a leg swinging like a pendulum, a volleyball arm swing, and a vertical jump as a simple projectile motion problem. It's also useful for biomechanics, like studying gait symmetry, posture, or the motion of the center of mass. While it doesn't give you true 3D coordinates with real-world units, it's more than enough for many educational or experimental setups, especially when paired with numerical simulations for comparison.

MediaPipe has mostly been applied in areas like augmented reality, fitness apps, and gesture recognition, but it's easy to see how those same tools can support innovation in physics education and research. If building a motion-based lab experiment or comparing experimental data to simulations, it offers a fast and on-device way to bring computation and real-world motion together.

References

https://github.com/google-ai-edge/mediapipe
https://ai.google.dev/edge/mediapipe/solutions/guide